dow, the normalization apparatus **200** performs normalization in consideration of the padding frames. For more accurate speech recognition, the normalization apparatus **200** normalizes frames belonging to the current extracted window in consideration of information on frames belonging to all windows that have been previously extracted. In this case, Equation 1 is used for normalization. However, the normalization method is not limited to this case. It is possible to normalize the current extracted window only some of the preceding windows, and when a size of the current extracted window is large enough for normalization, it is also possible to normalize the current extracted window using only the frames belonging to the current extracted window.

[0083] Subsequently, the normalization apparatus **200** determines whether there is another window to be extracted, that is, whether the current extracted window is the last window (**540**). When the current extracted window is not the last window, the process proceeds to operation **520** in which the normalization apparatus **200** extracts the next window.

[0084] After normalization is performed on the current extracted window in operation **530**, the speech recognition apparatus **100** of FIG. **1** may calculate acoustic scores by inputting the normalized frames belonging to the window into an acoustic model (**550**).

[0085] FIG. **6** is a flowchart of another example of a normalization method.

[0086] The normalization method of FIG. **6** is an example of a normalization method performed by the normalization apparatus **300** of FIG. **3**. The normalization apparatus **300** sequentially receives frames of a speech signal to be recognized (**610**).

[0087] Subsequently, when a number of frames corresponding to a preset window size have been input while frames of the speech signal are being input, the normalization apparatus **300** extracts a window as frame data to be input to an acoustic model (**620**). The normalization apparatus **300** may add padding frames to both sides of the current extracted window (not shown).

[0088] Subsequently, the normalization apparatus **300** determines whether there is sufficient information to normalize frames belonging to the current extracted window (**630**). For example, the normalization apparatus **300** compares a total number of frames that have been extracted, that is, a total number of frames including the first frame belonging to the first extracted window to the last frame belonging to the current extracted window with a preset reference value, and determines that there is insufficient information when the total number of frames is less than the reference value.

[0089] When it is determined that there is insufficient information to normalize the frames, the normalization apparatus **300** acquires additional frames from training data (**640**). For example, the normalization apparatus **300** acquires a number of frames corresponding to the difference between the reference value and the total number of frames that have been extracted from the training data.

[0090] Subsequently, the normalization apparatus **300** normalizes the frames belonging to the current extracted window in consideration of the frames of the preceding windows and the frames acquired from the training data (**650**). The normalization apparatus **300** calculates the average and the standard deviation according to Equation 2, and per-

forms normalization according to Equation 1 using the average and the standard deviation calculated according to Equation 2.

[0091] Subsequently, the normalization apparatus **300** determines whether there is another window to be extracted next, that is, whether the current extracted window is the last window (**660**). When the current extracted window is not the last window, the process proceeds to operation **620** in which the normalization apparatus **300** extracts the next window.

[0092] When normalization is performed on the current extracted window in operation **650**, the speech recognition apparatus **100** of FIG. **1** may calculate acoustic scores by inputting the frames belonging to the window into an acoustic model (**670**).

[0093] FIG. **7** is a block diagram of an example of an electronic device employing speech recognition technology.

[0094] Referring to FIG. **7**, an electronic device **700** includes a speech input unit **710**, a speech recognizer **720**, and a processor **730**. The speech recognizer **720** may be the speech recognition apparatus **100** of FIG. **1**.

[0095] The speech input unit **710** receives a speech signal input by a user through a microphone of the electronic device **700**. The speech signal of the user may be related to execution of commands embedded in the electronic device **700**, translation or interpretation of the speech signal into another language, TV control, vehicle cruise control, or navigation control.

[0096] When frames of the input speech signal are sequentially input, the speech recognizer **720** extracts windows to be input to an acoustic model from the input frame data. The speech recognizer **720** performs normalization in units of the extracted windows, and when padding frames are added to both sides of the windows, normalizes the windows together with the added padding frames. Also, when normalization is performed in units of windows, the speech recognizer **720** inputs the normalized windows to an acoustic model and a language model, gradually interprets acoustic scores and language scores, and outputs a recognition result.

[0097] When the speech recognition result is output, the processor **730** performs an operation corresponding to the speech recognition result. For example, the processor **730** may output the speech recognition result with a voice or in the form of text on a display and perform an operation of processing a command (e.g., TV control, such as power on/off and volume control, vehicle cruise control, or navigation control) embedded in the electronic device **700**. Also, the processor **730** may perform translation/interpretation. However, operations of the processor **730** are not limited thereto, and the processor **730** may be used in various fields other than those mentioned above.

[0098] The speech recognition apparatus **100**, the preprocessor **110**, the acoustic score calculator **120**, the language score calculator **130**, and the interpreter **140** in FIG. **1**, the normalization apparatus **200**, the window extractor **210**, and the normalizer **220** in FIG. **2**, the normalization apparatus **300**, the window extractor **310** and the normalizer **320** in FIG. **3**, and the electronic device **700**, the speech input unit **710**, the speech recognizer **720**, and the processor **730** in FIG. **7** that perform the operations described in this application are implemented by hardware components configured to perform the operations described in this application that are performed by the hardware components. Examples of hardware components that may be used to perform the operations described in this application where appropriate